

WHAT IS CLAIMED IS:

1                   1.       A system for forming and quenching glass sheets, comprising:  
2                   a furnace having entry and exit ends and including a heating chamber  
3                   having a conveyor for conveying glass sheets along a direction of conveyance  
4                   through the furnace from the entry end to the exit end;  
5                   the exit end of the furnace including a roll bending station within the  
6                   heating chamber, the roll bending station including a roll conveyor having  
7                   horizontally extending conveyor rolls that are rotatively driven and spaced  
8                   horizontally within the heating chamber along the direction of conveyance extending  
9                   laterally with respect thereto to support and convey the heated glass sheets, the roll  
10                  bending station having a pair of sets of bending rolls that are spaced laterally with  
11                  respect to each other within the heating chamber along the direction of conveyance,  
12                  and a drive mechanism that supports each set of the bending rolls with the rolls  
13                  thereof at progressively increasing inclinations along the direction of conveyance  
14                  and that provides rotational driving of the bending rolls to provide bending of the  
15                  conveyed glass sheets along a direction transverse to the direction of conveyance;  
16                  a press bending station located externally of the furnace downstream  
17                  along the direction of conveyance from the exit end of the furnace to receive the  
18                  bent glass sheets from the exit end of the furnace, the press bending station having  
19                  a lower ring mold and an upper press mold that have curved shapes along and  
20                  transverse to the direction of conveyance, and an actuator that provides relative  
21                  vertical movement between the lower ring mold and the upper press mold to bend  
22                  a glass sheet therebetween and cooperate with the roll bending station in forming  
23                  the glass sheet with curvatures both along and transverse to the direction of  
24                  conveyance; and  
25                  a quench station for rapidly cooling the formed glass sheet to provide  
26                  toughening.

1                   2.       A system for forming and quenching glass sheets as in claim  
2                   1 the drive mechanism is located externally of the furnace with the bending rolls  
3                   projecting inwardly into the furnace.

1                   3.       A system for forming and quenching glass sheets as in claim  
2       1 wherein the press bending station actuator moves the lower ring mold vertically  
3       to provide the glass sheet forming.

1                   4.       A system for forming and quenching glass sheets as in claim  
2       1 wherein the press bending station actuator moves the upper press mold vertically  
3       to provide the glass sheet forming.

1                   5.       A system for forming and quenching glass sheets as in claim  
2       1 wherein the press bending station actuator moves both the lower ring mold and  
3       the upper press mold vertically to provide the glass sheet forming.

1                   6.       A system for forming and quenching glass sheets, comprising:  
2                   a furnace having entry and exit ends and including a heating chamber  
3       having a conveyor for conveying glass sheets along a direction of conveyance  
4       through the furnace from the entry end to the exit end;  
5                   the exit end of the furnace including a roll bending station within the  
6       heating chamber, the roll bending station including a roll conveyor having  
7       horizontally extending conveyor rolls that are rotatively driven and spaced  
8       horizontally within the heating chamber along the direction of conveyance extending  
9       laterally with respect thereto to support and convey the heated glass sheets, the roll  
10      bending station having a pair of sets of bending rolls that are spaced laterally with  
11      respect to each other within the heating chamber along the direction of conveyance,  
12      and a drive mechanism that is located externally of the furnace and that supports the  
13      bending rolls at progressively increasing inclinations along the direction of  
14      conveyance as well as providing rotational driving of the bending rolls to provide  
15      bending of the conveyed glass sheets along a direction transverse to the direction  
16      of conveyance;  
17                  a press bending station located externally of the furnace downstream  
18      along the direction of conveyance from the exit end of the furnace to receive the  
19      bent glass sheets from the exit end of the furnace, the press bending station having  
20      a lower ring mold and an upper press mold that have curved shapes along and  
21      transverse to the direction of conveyance, and an actuator that moves both the lower

22 ring mold and the upper press mold vertically to bend a glass sheet therebetween  
23 and cooperate with the roll bending station in forming the glass sheet curvatures  
24 both along and transverse to the direction of conveyance; and  
25 a quench station for rapidly cooling the formed glass sheet to provide  
26 toughening.

1 7. A method for forming and quenching glass sheets comprising:  
2 conveying a glass sheet within a heating chamber of a furnace  
3 from an entry end thereof toward an exit end thereof to provide heating thereof for  
4 forming;

5 continuing to convey the heated glass sheet on rotary horizontally  
6 extending rolls within the furnace heating chamber adjacent the exit end of the  
7 furnace and engaging opposite lateral sides of the roll conveyed glass sheet with a  
8 pair of sets of rotatively driven bending rolls that are spaced laterally from each  
9 other within the furnace heating chamber with each set having a plurality of bending  
10 rolls spaced along the direction of conveyance with progressively increasing  
11 inclinations to provide bending of the conveyed glass sheets along a direction  
12 transverse to the direction of conveyance;

13 conveying the bent glass sheet out of the heating chamber of the  
14 furnace through the exit end thereof to between a lower ring mold and an upper  
15 press mold that have curved shapes along and transverse to the direction of  
16 conveyance;

17 providing relative vertical movement between the lower ring mold  
18 and the upper press mold to bend a glass sheet therebetween and cooperate with the  
19 initial roll bending to form the glass sheet curvatures both along and transverse to  
20 the direction of conveyance; and

21 thereafter rapidly cooling the formed glass sheet to provide  
22 toughening.

1 8. A method for forming and quenching glass sheets as in claim  
2 7 wherein each set of bending rolls is rotatively supported and driven from  
3 externally of the furnace with the bending rolls thereof projecting into the heating  
4 chamber.

1                   9.     A method for forming and quenching glass sheets as in claim  
2     7 wherein the lower ring mold is moved vertically to press bend the glass sheet.

1                   10.    A method for forming and quenching glass sheets as in claim  
2     7 wherein the upper press mold is moved vertically to press bend the glass sheet.

1                   11.    A method for forming and quenching glass sheets as in claim  
2     7 wherein both the lower ring mold and the upper press mold are moved vertically  
3     to press bend the glass sheet.

1                   12.    A method for forming and quenching glass sheets comprising:  
2                   conveying a glass sheet within a heating chamber of a furnace  
3     from an entry end thereof toward an exit end thereof to provide heating thereof for  
4     forming;  
5                   continuing to convey the heated glass sheet on rotary horizontally  
6     extending rolls within the furnace heating chamber adjacent the exit end of the  
7     furnace and engaging opposite lateral sides of the roll conveyed glass sheet with a  
8     pair of sets of bending rolls that are rotatively supported and driven from externally  
9     of the furnace and spaced laterally from each other with each set having a plurality  
10    of bending rolls projecting into the heating chamber and spaced along the direction  
11    of conveyance with progressively increasing inclinations to provide bending of the  
12    conveyed glass sheets along a direction transverse to the direction of conveyance;  
13                  conveying the bent glass sheet out of the heating chamber of the  
14    furnace through the exit end thereof to between a lower ring mold and an upper  
15    press mold that have curved shapes along and transverse to the direction of  
16    conveyance;  
17                  moving both the lower ring mold and the upper press mold vertically  
18    to bend a glass sheet therebetween and cooperate with the initial roll bending to  
19    form the glass sheet curvatures both along and transverse to the direction of  
20    conveyance; and  
21                  thereafter rapidly cooling the formed glass sheet to provide  
22    toughening.